

Remarks

The following comments are provided in support of the claims presented. Applicants respectfully request reconsideration of the claims and entry of the amendments presented herein.

1. § 102 Rejection

Claims 53-55, 59-60, 61-62 and 69-83 have been rejected under 35 U.S.C. 102(b) as being anticipated by Sozuer et al (Journal of Modern Optics, vol. 41, pp. 231-239, 1994).

Sozuer discloses a photonic bandgap structure (i.e. a woodpile structure) that comprises a plurality of layers of stacked metal rods or wires without any disclosure of a supporting substrate as required by Applicants' independent Claim 52 and dependent Claims 53-55 and 59-60. The use of metal rods or wires in Sozuer can be seen in the third full paragraph on page 232:

To illustrate the utility of this new method, they calculated the photonic bands for a two-layer structure where **metal rods** were laid down parallel to the x-axis in one layer and in the second layer they were parallel to the y-axis. Repeating this pattern in the z-direction, one obtained a remarkably simple geometry. (emphasis added)

and in the first paragraph under Results section on page 236:

The recipe for building the structure proposed by Pendry was simple enough: place **wires** separated by a certain distance all parallel to the x axis; place another layer on top of the first, but this time with the wires parallel to the y axis; repeat. There are many improvizations on this structure that can readily be made. The most obvious is to use **wires** of rectangular cross-section.(emphasis added)

Applicants urge that there is no disclosure in Sozuer for Applicants' essential claim limitation of "a first plurality of rods **formed on a substrate**" as recited in independent Claim 52. Therefore, since Sozuer does not disclose a substrate, then Claims 53-55 and 59-60 cannot be anticipated by Sozuer. Applicants further note that the Office has not rejected independent Claim 52 under 35 U.S.C. 102(b) so that Claim 52 cannot be anticipated by Sozuer.

With regard to Claims 53, 62, 72 and 79 these claims recite that “the first and second materials are selected from the group consisting of polycrystalline silicon, amorphous silicon, silicon nitride, silicon dioxide, silicate glasses, III-V semiconductors, II-VI semiconductors, II-IV semiconductors, transparent oxides, sol-gel glasses and spin-on glasses.” Sozuer does not disclose the use of any of the above materials for forming his photonic bandgap structure, but instead discloses that the structure is formed of **metal rods or wires** as cited above. Therefore, Claims 53, 62, 72 and 79 cannot be anticipated by Sozuer, but instead are allowable.

With regard to Claim 54, this claim recites a structure “wherein a third material is substituted for the first or second materials after formation of the first, second and third plurality of rods.” The Office has not shown where in Sozuer such a “third material” is disclosed so that Applicants respectfully submit that the Office has not made a valid *prima facie* case of anticipation for Claim 54 so that this claim is allowable. If such a “third material” is present in Sozuer, it is incumbent on the Office to point out for the record exactly where such disclosure is found.

With regard to Claim 61, this claim recites a requirement for two distinct types of layers “honeycomb layers” and “interconnection layer[s]” to be sandwiched together to form the claimed structure. These two types of layers are shown in the example of Fig. 6 which is described in the second and third paragraphs on page 18. Applicants “honeycomb layer” has a “continuous hexagonal structure” in “**each** honeycomb layer” as recited in Claim 61. Applicants respectfully submit that this is not the case for Sozuer who disclose that each layer comprises parallel metal rods or wires that do not intersect each other in each layer and therefore cannot be said to form a “continuous hexagonal structure” in “**each** honeycomb layer” as required by Claim 61. The Office states on page 2 of paper no. 8 that “Sozuer also discloses photopic band structures in hexagonal lattice, which resulted from plurality of honey comb layers as shown in fig. 1).” Applicants respectfully submit that the hexagonal lattice shown in Fig. 1(b) of Sozuer requires three stacked layers of parallel metal rods or wires with each layer being rotated by 120 degrees. This is different from

Applicants' Claim 61 which requires **each** layer to comprise a "honeycomb structure" having a "continuous hexagonal structure." None of the layers of Sozuer individually form a "honeycomb structure" with a "continuous hexagonal structure" as required by Claim 61 since each layer of Sozuer only comprises a plurality of parallel spaced-apart metal rods or wires that are not connected together in any way.

Furthermore, Sozuer discloses only a single type of layer stacked up and rotated; whereas Claim 61 requires two distinct types of layers, namely "honeycomb layers" and "an interconnection layer sandwiched between each pair of adjacent honeycomb layers." Since Sozuer discloses only a single type of layer of parallel metal rods or wires stacked up, there is no 1:1 correspondence between Sozuer and the recited elements of Claim 61 as required for a valid *prima facie* case of anticipation. Additionally, the Office has not shown where in Sozuer any "interconnection layer" is disclosed with the interconnection layer having "dots" of material for interconnecting a pair of adjacent honeycomb layers as required by Claim 62. Therefore, Applicants respectfully submit that the Office has not made a valid *prima facie* case of anticipation for the rejection of Claim 61 so that Claim 61 and Claims 62 and 69 stemming therefrom are allowable.

With regard to Claim 70, this claim recites a requirement for two distinct types of layers: "honeycomb layers" and "intervening layer[s]" for connecting adjacent honeycomb layers together. An example of such a structure is shown in Fig. 6 and described on page 18. Applicants respectfully submit that Sozuer discloses only a single type of layer comprising a plurality of parallel metal rods or wires stacked up so that there is no 1:1 correspondence between Sozuer and each recited element of Claim 70 as required for a valid *prima facie* case of anticipation. Additionally, the Office has not shown where in Sozuer any "intervening layer" is disclosed for connecting adjacent "honeycomb layers" together as is required by Claim 70. Therefore, Applicants respectfully submit that the Office has not made a valid *prima facie* case of anticipation for the rejection of Claim 70 so that Claim 70 and Claims 71-75 stemming therefrom are allowable.

With regard to Claims 74 and 81, these claims recite honeycomb layers or hexagonal-pattern layers having a thickness “equal to one-quarter of the length of each rod.” Applicants respectfully submit that these essential claim limitations are not disclosed in Sozuer. Sozuer utilizes metal rods or wires that extend along the entire length of the device so that the thickness of each metal rod or wire is much smaller than one-quarter of the length of each rod or wire. This is clearly shown in Fig. 1. Therefore, since Sozuer lacks the essential claim limitation of honeycomb layers or hexagonal-pattern layers with these layers further having a thickness “equal to one-quarter of the length of each rod,” then Claims 74 and 81 must be allowable.

With regard to Claims 75 and 82, these claims recite an intervening layer or an interconnection layer having a thickness that is “twice the thickness” of the honeycomb layers or hexagonal pattern layers. This essential claim limitation is not disclosed in Sozuer who discloses that each layer is of the same thickness (see Fig. 1) and is formed from metal rods or wires all of the same thickness. Applicants respectfully submit that the Office has not shown where Sozuer discloses the essential claim limitation of any honeycomb layers or hexagonal pattern layers with these layers further having “twice the thickness” of other layers so that the Office has not made a valid *prima facie* case for the anticipation of Claims 75 and 82 based on Sozuer. Therefore, these claims are allowable.

With regard to Claim 76, this claim recites a structure comprising “a plurality of stacked hexagonal-pattern layers of interconnected rods separated by intervening interconnection layers having a triangular array of dots formed therein.” Thus, the structure comprises two different and distinct types of layers: (1) “hexagonal-pattern layers” and (2) “intervening interconnection layers having a triangular array of dots formed therein.” An example of such a structure is shown in Fig. 6 and described on page 18. As discussed above, Sozuer discloses only a single type of layer so that there is no 1:1 correspondence between each and every element of Applicants’ Claim 76 and Sozuer as required for a valid *prima facie* case of anticipation. Figure 1 cited by

the Office on page 2 of paper no. 8 for the § 102 rejection of Claim 76 does not show any “interconnection layers having a triangular array of dots formed therein” as required by Claim 76. Additionally, the Office has not shown where in Sozuer such “intervening interconnection layers” with “a triangular array of dots formed therein” are disclosed so that the Office has not made a valid *prima facie* case of anticipation for the rejection of Claim 76. Therefore Claim 76 and Claims 77-83 stemming therefrom are allowable.

2. § 103 Rejection

Claims 52-83 have been rejected under 35 U.S.C. § 103(a) as being obvious over Noda et al (*Jpn. J. Appl. Phys.*, vol. 35, pp. L909-L912, 15 July 1996) or Fleming et al (US 6,468,348) or Gruning (DE 19743296) in combination with Sozuer et al.

The Office states on page 4 of paper no. 8 that the subject matter Gruning et al (DE 19743296 C) is the same as Gruning (US 6,468,348). Furthermore, the Office has provided no English translation of Gruning et al (DE 19743296 C), and no such English translation is readily available to Applicants. Therefore, Applicants will direct their remarks to Gruning (US 6,468,348) which is in English.

For a valid *prima facie* case of obviousness, there must be some teaching or suggestion in the art of record to form Applicants’ claimed invention. Applicants respectfully submit that the Office has not shown the requisite motivation for a valid *prima facie* case of obviousness for the rejection of Claims 52-83 based on the combination of Noda or Fleming or Gruning taken in combination with Sozuer. The Office states on page 3 of paper no. 8: “But Noda or Fleming or Gruning do not teach rotation of each set of rods resulted from single semiconductor layer is rotated 120 degrees from the adjacent rods.” The Office further states on page 3 of paper no. 8: “It would have been obvious to form hexagonal or triangular lattice by rotating each set of rods from the adjacent set by 120 degrees from the honeycomb of layers in the invention of Noda or Fleming or Gruning as suggested by Sozuer et al for variety of optoelectronic devices.”

Applicants respectfully submit that the statement by the Office “for variety of optoelectronics devices” is not motivation for one skilled in the art to form Applicants’ claimed invention by modifying Noda or Fleming or Gruning according to Sozuer since this phrase is nebulous and uncertain and could lead in many different directions with no certainty of forming Applicants’ claimed invention. Indeed, Applicants urge that the woodpile structures disclosed in Noda or Fleming or Gruning already have potential utility “for a variety of optoelectronics devices” so that one skilled in the art would not be motivated to deviate from these structures, but instead would be motivated to further develop and explored these woodpile structures “for a variety of optoelectronics devices” rather than adopting the structure in Fig. 1(b) of Sozuer.

Furthermore, Sozuer does not disclose that the three-layer structure of Fig. 1(b) has any particular advantage over any of the other structures in Fig. 1 or over the woodpile structures disclosed by Noda, Fleming and Gruning that would motivate one skilled in the art to adopt the structure in Fig. 1(b) of Sozuer. To the contrary, Sozuer discloses a clear preference for a four-layer structure of parallel metal rods or wires with each layer being rotated by 45 or 90 degrees as shown in Figs. 1(c) and 1(d) since this type of structure provides a larger gap. This is explicitly stated in Sozuer in the last paragraph on page 238:

We have shown that the two-layer woodpile structures do not have bandgaps, but with ordinary semiconductors with refractive indices of 3.5-4, the gaps are too small to be truly useful. We are currently exploring more complex structures with more than two layers. Our preliminary calculations with the four-layer structure have shown gaps of over 20%.

Applicants urge that, based on the above statements in Sozuer, one skilled in the art would not be motivated to fabricate a three-layer structure such as that shown in Fig. 1(b), but instead would be motivated to fabricate a four-layer woodpile structure as shown in Figs. 1(c) and 1(d) since this type of structure has the clear advantage of providing a gap of over 20%. Such four-layer woodpile structures are disclosed in each of Noda, Fleming and Gruning. Therefore, Applicants respectfully submit that Sozuer teaches away from a three-layer structure as recited in Applicants’ claims 52-

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60 and away from the honeycomb structures recited in Claims 61-83. Such teaching away from Applicants' claimed invention is evidence for the *prima facie* unobviousness of Claims 52-83 based on this combination set forth by the Office. Therefore, Claims 52-83 are allowable.

The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. (*In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990.)) Applicants respectfully submit that the motivation set forth by the Office "for a variety of optoelectronics devices" does not suggest the desirability for one skilled in the art to deviate from the woodpile structures disclosed by Noda, Fleming and Gruning. To the contrary, Applicants have shown that Sozuer teaches a clear preference for a four-layer woodpile structure having parallel rods in each layer and with each layer being rotated by 45 or 90 degrees. This type of four-layer woodpile structure favored by Sozuer is similar to the woodpile structures disclosed by Noda, Fleming and Gruning so that one skilled in the art would not be motivated to deviate from such structures to form Applicants' claimed invention as recited in Claims 52-83. Therefore, Applicants respectfully submit that the Office has failed to provide the motivation required to form a valid *prima facie* case of obviousness for the rejection of Claims 52-83, so that Claims 52-83 are allowable. Furthermore, as discussed above, there is evidence in Sozuer for the *prima facie* unobviousness for Claims 52-83 based on the combination set forth by the Office.

With regard to Claims 61-69, these claims disclose a structure which comprises two different types of layers: (1) "honeycomb layers" and (2) "an interconnection layer sandwiched between each pair of adjacent honeycomb layers for interconnecting the adjacent honeycomb layers." Applicants respectfully submit that the art of record (Sozuer, Noda, Fleming and Gruning) discloses only a single type of layer stacked up repeatedly to form a "woodpile structure" with no teaching or suggestion for "an interconnection layer." Applicants further respectfully traverse the statement by the Office on page 3 of paper no. 8 that: "All primary references Noda, Fleming and Gruning essentially requires interconnection layer for producing

rods.” This statement by the Office is unfounded since each of the references Noda, Fleming and Gruning discloses that each layer of the structures therein is either stacked up on another layer of the same type or is formed in intimate contact with another layer of the same type. None of these references discloses an intervening layer of any kind for interconnecting adjacent layers.

In Noda, the patterned layers of the woodpile structure (i.e. the rods) are all formed from GaAs and waferbonded together. The AlGaAs layers in Noda are not patterned or used to form rods of the woodpile structure, but instead are used as etch-stop layers and removed prior to waferbonding so that the completed woodpile structure includes only rods formed from GaAs, with each layer of rods being of the same type and size stacked one upon the other as shown in Fig. 1(e). The AlGaAs layers in Noda cannot be considered as “an interconnection layer” as required for Claims 61-69 since the AlGaAs layers do not interconnect any adjacent layers as required by Claims 61-69. Furthermore, the AlGaAs layers in Noda comprise a different material than the GaAs layers, whereas Applicants’ Claims 61-69 require the interconnection layer to be formed from the same material (i.e. the first material) as the honeycomb layers. Therefore, Noda does not teach, suggest or disclose an “interconnection layer” as recited in Claims 61-69.

In Fleming, any material overlying a layer of rods is removed using chemical-mechanical polishing as described with reference to Fig. 3d so that each successive layer of rods can be formed upon a previous layer of rods of the same size and type without any interconnection layer therebetween (see Fig. 3e and Fig. 3h and col. 7, lines 15-19). The resulting structure in Fleming does not include “an interconnection layer sandwiched between each pair of adjacent honeycomb layers for interconnecting the adjacent honeycomb layers at vertices of the hexagonal structure” as required for Claims 61-69. Thus, there is no teaching, suggestion or disclosure in Fleming for an “interconnection layer” having a different structure from the adjacent layers but being formed of the same material as the adjacent layers.

In Gruning, each layer of the structure is epitaxially grown on a previous

layer “to maintain and continue the monocrystalline structure that is originally present.” (col. 4, lines 30-34). Thus, Gruning discloses that the rods formed in each layer being are in direct contact with the rods of each adjacent layer, with no “interconnection layer” being present between adjacent layers of the rods (see Fig. 1 and col 4, lines 4-6 and 19-48). Therefore, Gruning does not disclose Applicants’ essential claim limitation of “an interconnection layer sandwiched between each pair of adjacent honeycomb layers for interconnecting the adjacent honeycomb layers” as recited in Claims 61-69.

Sozuer discloses that one layer of metal rods or wires is stacked upon another layer of the same type, with no teaching or suggestion for any “interconnection layer sandwiched between each pair of adjacent honeycomb layers for interconnecting the adjacent honeycomb layers” as recited in Claims 61-69. The stacking of one layer of metal rods or wires on top of another layer of the same type is disclosed in Sozuer in the first paragraph of the “Results” section on page 236. Therefore, Sozuer does not teach, suggest or disclose Applicants’ “interconnection layer” as recited in Claims 61-69 which comprises “dots” of material.

Additionally, none of Noda, Fleming, Gruning or Sozuer disclose a “honeycomb layer” having a “continuous hexagonal structure” as recited in Claims 61-69. Such honeycomb layers are shown as layers 1 and 3 in Applicants’ example of Fig. 6 and are disclosed as being distinct from “a Lincoln-Log structure” which “looks like a carefully stacked pile of logs” (see second paragraph on page 11 and description for Figure 6 on page 10) and as not fitting within the definition of a Lincoln-Log structure (see second and third paragraphs on page 18). Applicants further show such a “Lincoln-Log structure” in Fig. 1 to have a construction similar to the “woodpile structure” disclosed by Noda, Fleming, Gruning and Sozuer each of which comprises a plurality of stacked rods extending the entire length or width of the structure. Therefore, Applicants urge that since the “honeycomb layer” having a “continuous hexagonal structure” as recited in Claims 61-69 is not a “Lincoln-Log structure” and “does not fit within the definition of a Lincoln-Log structure,” then it would not be obvious to form Applicants’ Claims 61-69 starting with a “Lincoln-Log

structure” as disclosed in each of Noda, Fleming, Gruning and Sozuer. Each layer in the structures of Noda, Fleming, Gruning and Sozuer is formed from a plurality of spaced-apart parallel rods that extend the entire length or width of the structure and do not intersect at any point within any individual layer, and therefore cannot be said to be interconnected to form a “continuous hexagonal structure” in “**each** honeycomb layer” as required by Claims 61-69.

In the structures of Sozuer in Fig. 1(b), adjacent layers of parallel metal rods or wires are rotated by 120 degrees and may be in contact at certain points, but do not form a “continuous hexagonal structure” in **each** layer as required by Claims 61-69. Forming Applicants’ “continuous hexagonal structure” requires that the rods be truncated and interconnected in **each** layer as shown in the example of Fig. 6. This is contrary to each of Noda, Fleming, Gruning and Sozuer who require the rods to extend the entire length and width of their structures and who do not teach or suggest any interconnection of the parallel rods in **each** layer.

In view of the above discussion, Applicants respectfully submit that the art of record does not teach or suggest either of Applicants’ essential claim limitations of (1) “honeycomb layers” having “a continuous hexagonal structure” and (2) “an interconnection layer sandwiched between each pair of adjacent honeycomb layers” so that the Office has not made a valid *prima facie* case of obviousness for the rejection of Claims 61-69. Therefore, Claims 61-69 are allowable.

With regard to Claims 70-75, the arguments presented above for Claims 61-69 apply. Namely, there are two types of layers recited in Claims 70-75: (1) “honeycomb layers” having a “continuous hexagonal structure” and (2) “an intervening layer” connecting “adjacent honeycomb layers.” The art of record (Noda, Fleming, Gruning and Sozuer) does not teach or suggest the formation of either type of layer recited in Claims 70-75. With regard to “honeycomb layers,” Claims 70-75 require that these layers be formed from “interconnected rods arranged in a continuous hexagonal structure” in **each** honeycomb layer so that “adjacent honeycomb layers” can be “connected together through an intervening layer.” This requirement for the “continuous hexagonal structure” to be formed from a single layer according to

Applicants' Claims 70-75 is further supported by the example of Fig. 6 which is described on page 18. Noda, Fleming and Gruning do not teach or suggest any type of individual layers that could be considered to be "honeycomb layers." Sozuer discloses in Fig. 1(b) a structure that the Office cites for a hexagonal lattice, but this structure is formed from three different layers and does satisfy the requirement of Claims 70-75 for a "continuous hexagonal structure" formed from "interconnected rods" in **each** "honeycomb layer." The parallel metal rods or wires in the three layers in Fig. 1(b) of Sozuer are simply stacked up and cannot be considered to be "interconnected rods arranged in a continuous hexagonal structure" in a single layer as required by Claims 70-75.

Additionally, there is no teaching or suggestion in any of Noda, Fleming, Gruning and Sozuer for "an intervening layer" as recited in Claims 70-75 that connects together "adjacent honeycomb layers." In each of Noda, Fleming, Gruning and Sozuer the parallel unconnected rods forming each layer are in contact with the rods of adjacent layers with no teaching or suggestion for any other type of layer being therebetween to act as an "intervening layer." In Noda each layer of the woodpile structure is formed from GaAs, with adjacent GaAs layers being waferbonded together with no other layers in between. In Fleming, any material overlying a layer of rods is removed using chemical-mechanical polishing so that each successive layer of rods is formed in contact with a previously-formed layer of rods without any "intervening layer" in between. In Gruning, each layer of rods is epitaxially grown on a previous layer to provide an intimate contact therebetween (i.e. "to maintain and continue the monocrystalline structure that is originally present") thereby precluding the possibility for any "intervening layer." In Sozuer, the layers are formed from metal rods or wires that are stacked up layer by layer with no "intervening layer" separating any of the layers of metal rods or wires.

Applicants respectfully submit that the Office has not shown where in any of Noda, Fleming, Gruning and Sozuer there is any teaching or suggestion for the two types of layers recited in Claims 70-75, namely "honeycomb layers" having a "continuous hexagonal structure" and "an intervening layer" connecting "adjacent

honeycomb layers.” Therefore, Applicants urge that the Office has not made a valid *prima facie* case of obviousness for the rejection of Claims 70-75 so that these claims are allowable.

With regard to Claims 76-83, these claims also recite two different types of layers: (1) “hexagonal-pattern layers of interconnected rods” and (2) “intervening interconnection layers having a triangular array of dots formed therein” with “the dots connecting vertices of the interconnected rods of one hexagonal-pattern layer to the vertices of the interconnected rods of an adjacent hexagonal-pattern layer.” As described above, the art of record (i.e. Noda, Fleming, Gruning and Sozuer) does not teach or suggest any single layers having a hexagonal structure therein, or any layers of a completely different type for interconnecting hexagonal-pattern layers. In paper no. 8, the Office has not shown any teaching or suggestion in the art of record for any “intervening interconnection layers having a triangular array of dots formed therein.” As described above, no intervening or interconnection layers are present in any of Noda, Fleming, Gruning and Sozuer. Furthermore, none of these references disclose any “triangular array of dots” as required for the “intervening interconnection layers” in Claims 76-83, with these “dots” being used for “connecting vertices of the interconnected rods of one hexagonal-pattern layer to the vertices of the interconnected rods of an adjacent hexagonal-pattern layer.” Therefore, Applicants respectfully submit that the Office has not made a valid *prima facie* case of obviousness for the rejection of Claims 76-83 so that these claims are allowable.

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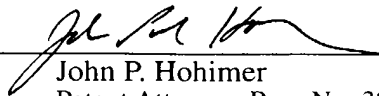
Conclusion

Applicants have responded to each and every rejection and urge that the Application is in condition for allowance. A favorable reconsideration is earnestly solicited.

Respectfully submitted,

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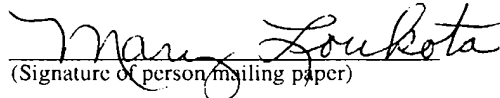
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